

Interactive comment on “Production, growth and properties of ultrafine atmospheric aerosol particles in an urban environment” by I. Salma et al.

Anonymous Referee #1

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General Comments:

This paper provides a year of carefully measured data on the number concentrations and size distributions of ultrafine particles in Budapest. It appears that this is the first such data published for this region. As such the data are of considerable interest.

Thorough analysis of this data is performed. The size distributions are de-convoluted into two or three particle size types using a “Do Fit” routine. Daily median concentrations are determined and compared to results from other sites. The temporal variability of the number concentrations is examined along with the temporal variability of the NMMD for some days. Nucleation events were classified visually and their seasonal

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frequency is reported.

Despite the interesting data and detailed analysis the paper suffers from some weaknesses that significantly detract from its quality. The weaknesses range from wording that is unclear to unsubstantiated statements. Few specific conclusions are drawn relevant to these data, or Budapest. Thus, by the end of the paper the reader is left unsure as to what they have learnt about ultrafine particles in Budapest, or in urban environments in general.

Specific comments are provided below in order to help improve the manuscript and hopefully make it suitable for publication.

Specific Comments:

Abstract

L16: This shift to larger values was not noted in the paper. The presence of aged aerosol was stated as a fact with no supporting evidence. L19 Please clarify. Is the author saying that nucleation did not increase particle number? This does not make sense. L20. The meaning of this ratio is not clear. Is this the ratio of the nucleation to total particle numbers or the ratio of the number concentration before and after nucleation?

Introduction

P13691 L23 Particles from vehicle emissions down to 10 nm are often seen. Where did this typical range of 20-100 nm given by the authors for vehicles come from?

P13692 L9; The maximum UFP from morning rush hour is often near 8:00 or 9:00 a.m. at other sites. When is it in Budapest? What time is meant by early morning?

P13692L25 What is meant by primary ultrafine? Are the authors equating point source emissions vs. distributed processes such as nucleation? Where do distributed vehicle emissions across cities vs. SO₂ released by a point source fit into this distinction?

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P13694 L19 What research questions were being addressed? Was the intent was presumably not to simply increase the amount of UFP data available in the literature? Were there unique aspects about this site (meteorology, topography, emission sources) that would suggest that findings here would differ from the data reported elsewhere?

P13694 L20 Is this is the first such data published for this region? If so the authors should state that this is the case.

Experimental

P13696 L14 Was a size calibration with PSL done? Were the possibilities of losses or miscalibration of larger particles evaluated? It appears that the median diameters obtained for the accumulation mode particles were quite a bit smaller than other cited values. Can evidence be provided so that the possibility that was due to instrument errors be rejected?

P13696 L19 Where is this data presented. Could a summary table be included for readers not familiar the meteorology of Budapest so that they can understand how it may differ from that of the other sites cited?

Results and Discussion

P13700 L17 The authors argue that the number concentration of particles between 6 and 1000 nm did not vary with seasons, and they mentioned that their results were different from some other studies conducted in the similar urban regions. However, they did not explain what would have made the differences between similar environments. This would be improved by adding possible explanations, for example, whether the gap came from topographical variations or different meteorological conditions. Further some seasonal tendency, lower in the summer, is in fact suggested by figure 2 whereas the authors claim none was observed. Were monthly averages calculated and a significance test used to establish that there was no significant seasonal tendency?

P13701 L6 Was the relationship between particle mass or surface area examined?

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While the authors are not sure whether background aerosols assist or suppress nucleation, their results showed the most frequent events in spring and the least frequent events in winter. If background aerosols are somehow correlated to nucleation and growth of particles, whether it is positive or negative, and the concentration of pre-existing particles was consistent throughout the year, then the nucleation frequency also should be consistent with the concentrations. It might be helpful to estimate nucleation-related parameters, such as condensation sink, and examine the condensation sink values throughout the year to comprehend the correlation between pre-existing particles and nucleation.

P13701 L24 The difference in NMMD of 150-250 vs. 93 seems large. Could instrument miscalibration have resulted in the collection of fewer large particles, causing the reduction in the median size of the accumulation mode? Could any of this difference be due to the measurement of dried particles?

P13702 L6 How is it a "fact" that aged aerosol dominates under conditions that favor nucleation? Are there references to support this statement? I would think that the opposite might be equally true at many sites. Could this shift not just be due to "pulling out" the nucleation mode when fitting these size distributions (i.e. a product of the fitting routine?) Did this observation apply to all the nucleation event days or just 8 May?

P13702 L12 Please define this ratio more clearly. It appears to be the ratio of a portion of the particles to the total number of particles. Is so, how can his ratio be greater than 1? Is this the ratio of the number concentration during the event to before the event?

P13703 L3 This sounds like speculation. Is the traffic volume constant after 2:30? Mixing is often greater in the afternoon and early evening at many sites resulting in lower number concentrations in the afternoon. Average diurnal plots of number concentration for the non-nucleation and nucleation days should be included rather than just growth curves for a few specific days. Including some information on the diurnal traffic patterns in Budapest would also help along with the ratio of diesel to spark ignition vehicles.

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P13703 L5 What makes these local? What is the associated "local" spatial scale: 1, 10 or 25 km?

P13703 L9 What is intended by "they"? Is "they" the growth events observed in Budapest or those reported by Jeong et al. If Jeong et al did not report data below 10 nm then what is the basis for the statement that their results were misinterpreted? Further are the authors saying that SO₂ did not contribute to nucleation in Budapest or generalizing to other sites?

P13703 L11 What causes this photochemical growth to occur on some days and not others? Is there day to show that these days were more photochemically active. For example, are the concentrations of other photochemically derived compounds (e.g. ozone) higher on these days?

P13703 L19 The authors state that the mixing of the air in the morning dropped the N₂₅₋₁₀₀₀ concentration, and this, together with solar radiation, led to conditions conducive to nucleation. They claim that the mixing of the air diluted background aerosols while it raised the SO₂ and influenced temperature. Are there data to support this change in PM, SO₂ and temperature, solar intensity or is this speculation?

P13703 L23 What do you mean by wide onset? Why is the 6 h duration uncertain ("probably indicates") ?

P13703 L29 Why would the shift be sudden? Is this a product of the fitting routine changing from three to two NMMD?

P13704 L21 How does this 83 events relate to the 45 and 31 reported on line 6 and 7 of page 13698?

P13704 L24 What about the days with undefined features or missing data?

P13704 L29 I'm not sure of the meaning here. Can you express this some other way? (e.g. spatially homogeneous) Regardless of the wording are you suggesting that an air mass during a nucleation event should be isotropic and hence that the shape of the

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growth curve would be the same regardless of wind speed or direction?

P13705 L14 Does the seasonal variation of solar radiation differ between the sites you have cited in a way that would explain the differences in nucleation frequency?

P13705 L24 Please include a summary of your findings here as otherwise this comes across as just a general list of all the possible factors that might influence nucleation with no relevance to what was observed (i.e. your results).

P13706 L24 How does the increased concentration of condensing species in summer balance against the increased driving force for condensation in the winter? Why is summer favored? Perhaps temperature does not drop that much in Budapest in winter?

P13707 L21 Which are the regional events? I understood that most events had a city wide scale of 9 to 33km? Is this regional?

Conclusions

These conclusions appear to be further discussion, some of which could have been stated before doing the study. What were the specific conclusions drawn for this study? What did we learn?

P13708 L10 Do these comparisons with rural and background environment relate to this study? Only urban results were presented and I don't recall seeing much comparison to rural results within the discussion section.

P13708 L19 This conclusion is a bit vague, Was a purpose of the study to evaluate the performance of the switching type DMPS and "advanced evaluation methods" If so what data was provided to demonstrate these capabilities. The DoFit peak deconvolution seems elegant but I still wonder if it induces artifacts when the size distributions approach each other (e.g. the rapid growth in NMMD in fig 5a at 2:30)

Figure3: The separation of the Aitken and accumulation mode particles seems a bit arbitrary in figure 4a. Is the assumption that they originate from different sources justi-

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ifying the resolution into two types? Did a separation into two types (vs. three or four) give the best fit? Is there a reason to assume the distributions should be log normal and is such an assumption needed to justify this fitting?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13689, 2010.